Blue Fields: Offshore Single Point Mooring Array for Efficient, High-Yield Tropical Macroalgal Production

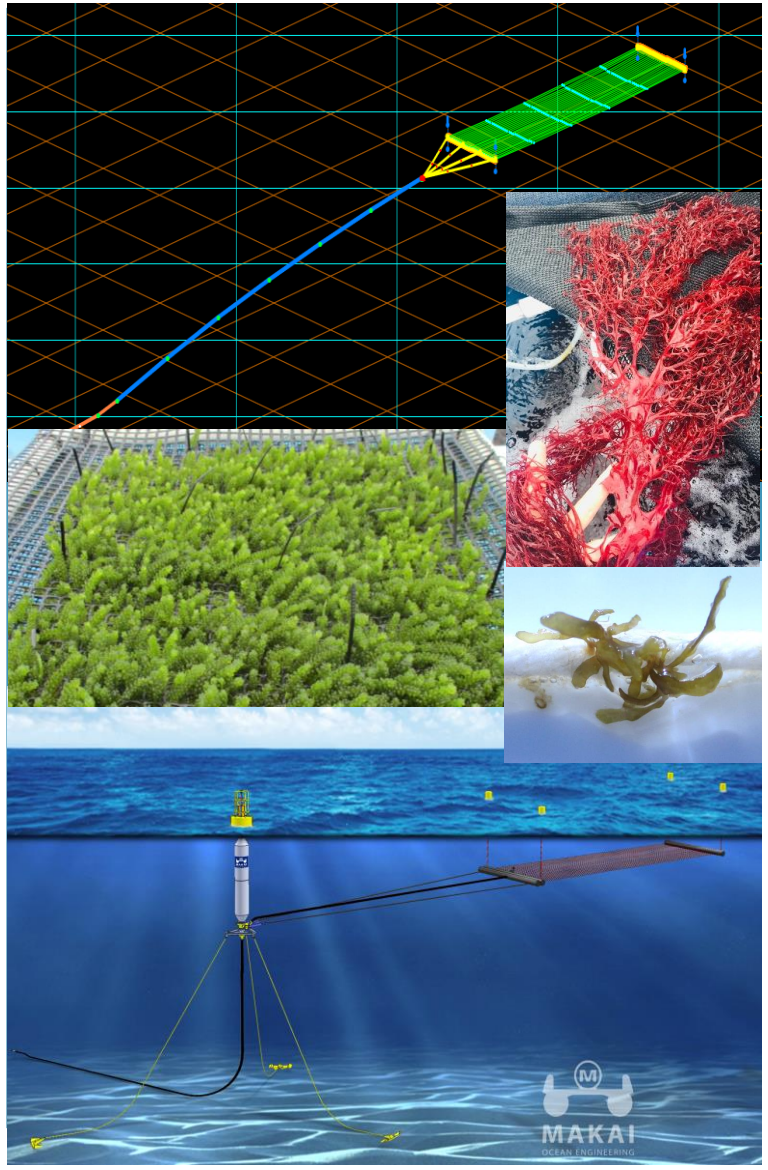
Neil Anthony Sims, Ocean Era, Inc

Project Vision:

Blue Fields opens up vast tropical waters to macroalgal cultivation with no external energy or nutrients

Project Impact: *To demonstrate:*

- ***Tropical*** *offshore macroalgae culture*
  - *Year-round insolation*
  - *Placid sea states*
  - *Low turbidity – deeper arrays*
  - *Warmer – faster rate of biodigestion*
- ***SPM*** *efficiencies – nutrients, harvest*
- ***Passive*** *DSW nutrient enrichment*



Project Team

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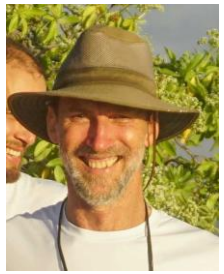



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Innovation & Objectives

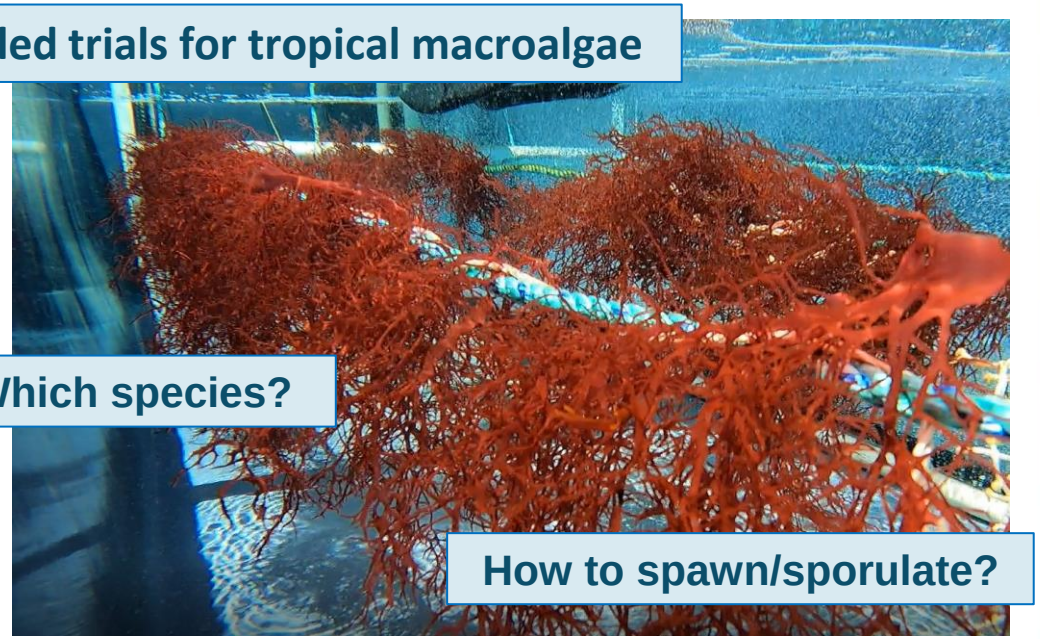
Offshore macroalgae culture in tropical waters

Innovation

Primary impediment: a dearth of replicated, controlled trials for tropical macroalgae

Blue Fields will therefore pioneer:

- **Kona land-based tank trials** – obtaining empirical data for tropical macroalgae growth responses to environment (sunlight, nutrients, currents) for a range of candidate species
- Tropical macroalgae **reproductive cues** – to allow scale-up of line-seeding
- **Deep seawater (DSW)** – as an abundant, extensive nutrient source
- Cost effective **deep-water moorings**, to extend usable range of EEZ.
- **Swivel mooring or SPM** maximizes efficiency of nutrient dispersal
- **Wave-driven spar pump** - renewable-powered nutrient supply
- Automated **"Spider seeding"** – harnessing longitudinal currents
- **Harvest system** – demonstrate elements of harvest process



What market returns?

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CHANGING WHAT'S POSSIBLE

Technology Progress

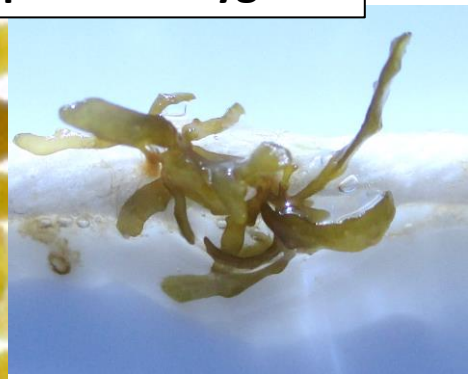
Land-based hatchery and growth trials

Native species selection

Sargassum aquifolium
Halymenia hawaiiana
Ulva ohnoi
Caulerpa lentillifera
Gracilaria parvispora ??

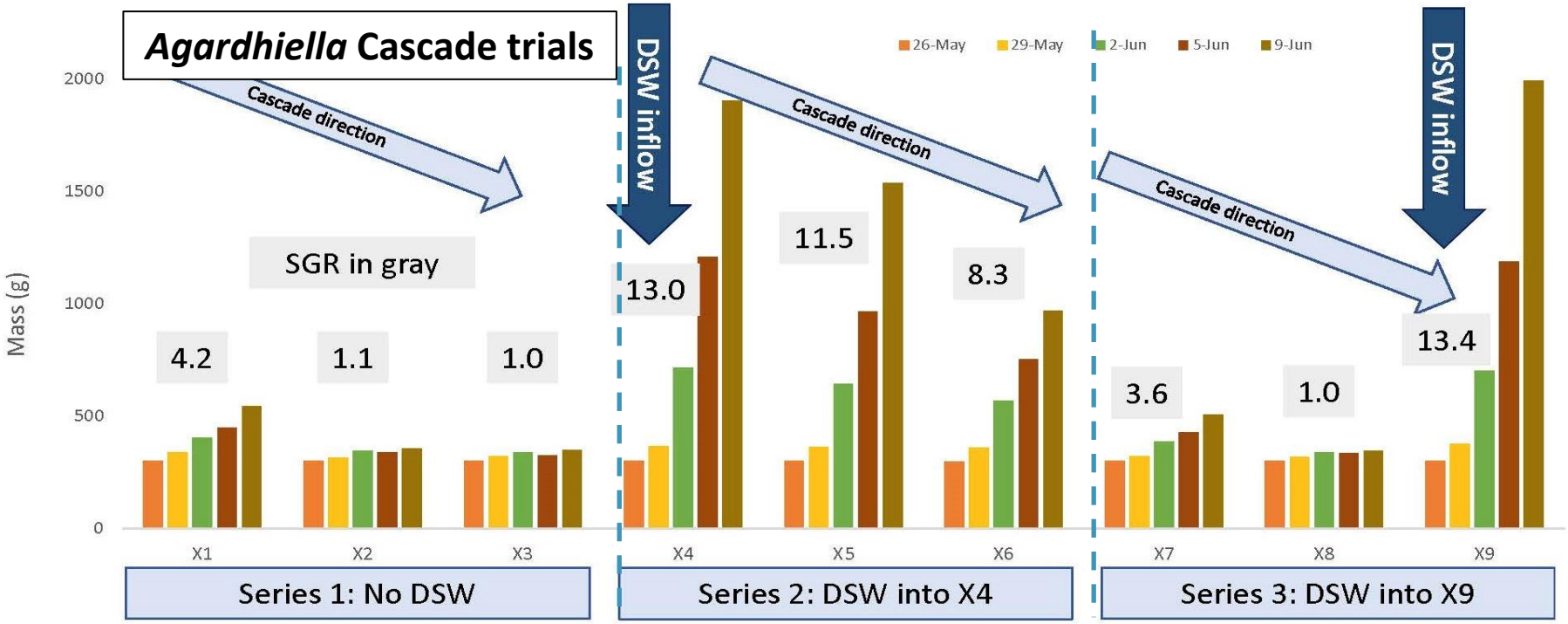
Biofouling (diatom) control

Sargassum spawning, 'paint-on' zygotes



Ulva sporulation to strings

Agardhiella Cascade trials



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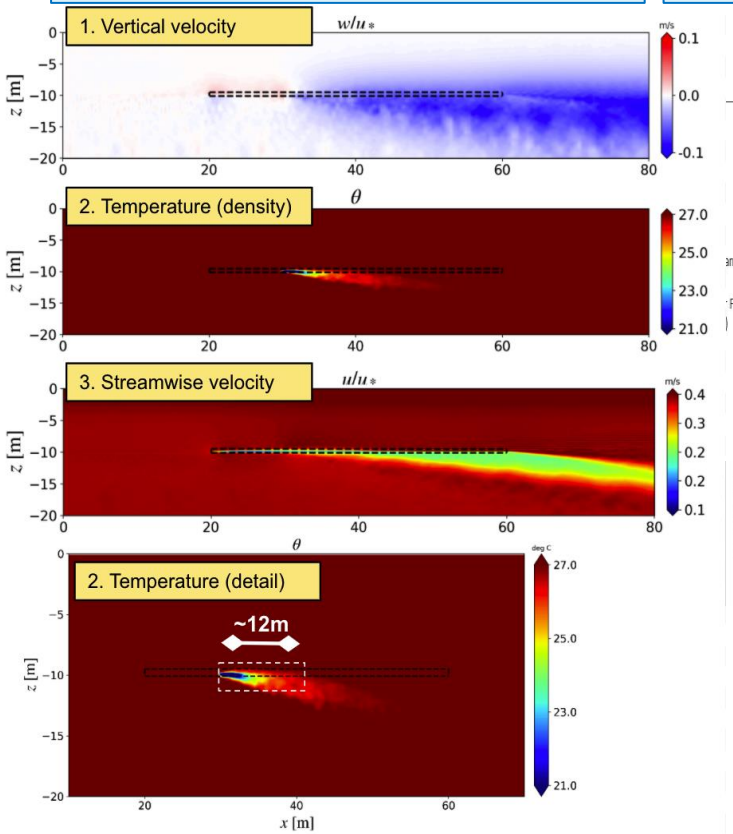
Technology Progress

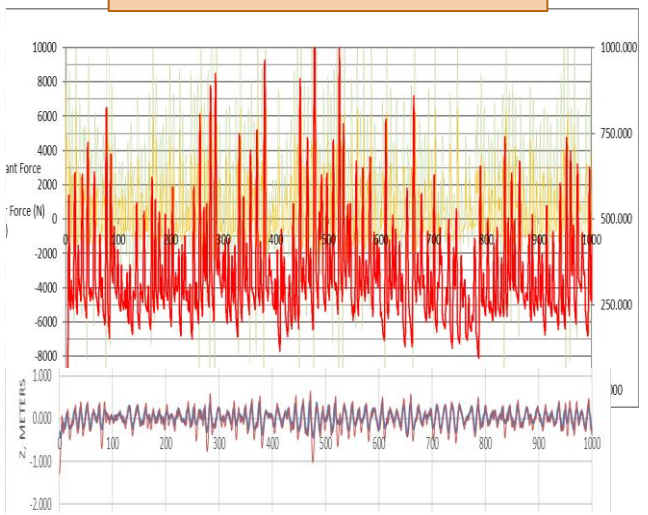
Offshore array planning and modeling

Refined modeling of plume and nutrient availability

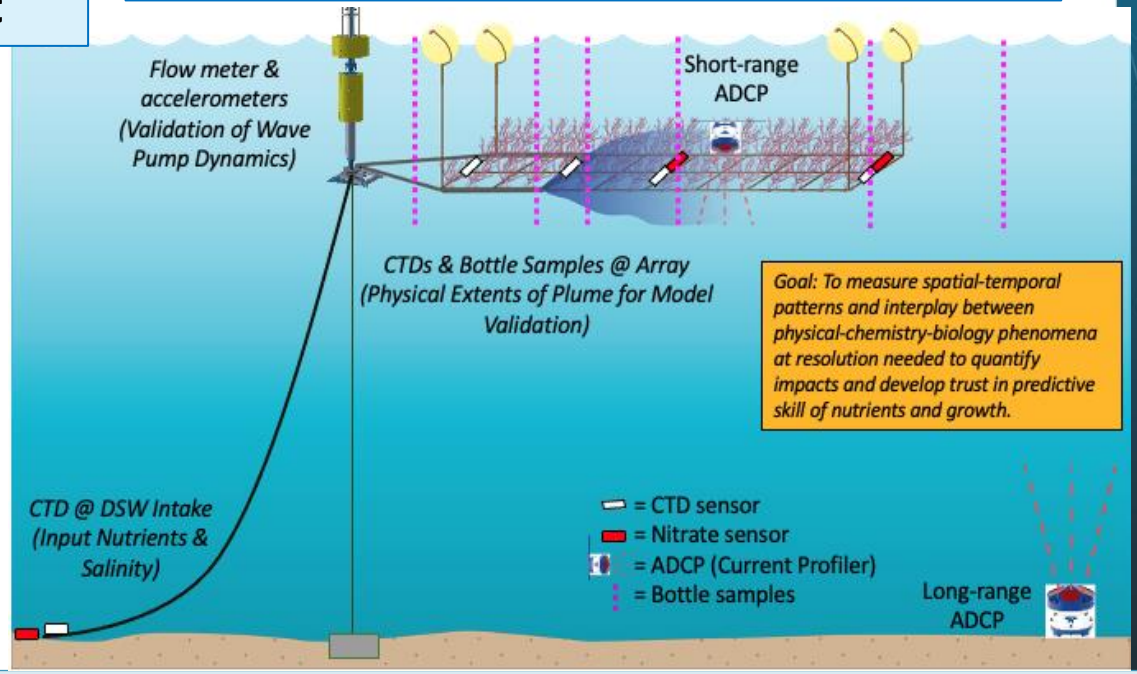


Model for wave pump performance, DSW availability, and DSW cost

8” intake : 335 gpm



Plan for Data Collection for Model Validation



DSW Costs / Benefits? N concentration v. flow rate?

Nitrite/Nitrate levels (µg N/L)	
SSW	3.6
DSW	578
150 m intake water	35
150 m @ 2% dilution	0.7

3-PT swivel mooring w DSW pipe to 150 m
Cap Ex + Deployment/retrieval ~ $1.3M

SPM w no DSW ~ 25% of cost
Use flume tanks for replicated DSW trials

LCA will focus on carbon budget (DSW pH ~ 7.6)

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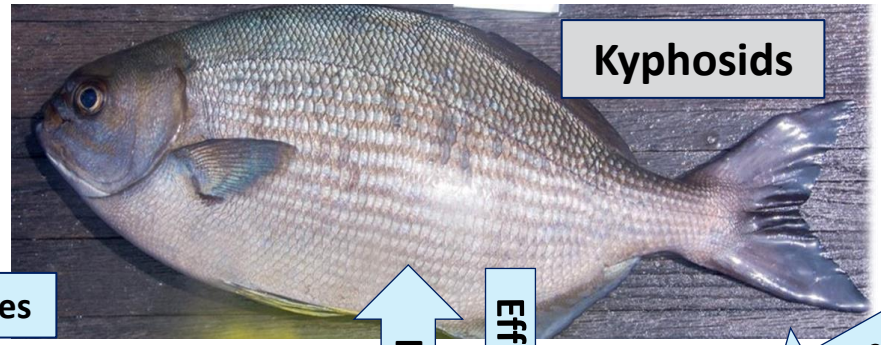
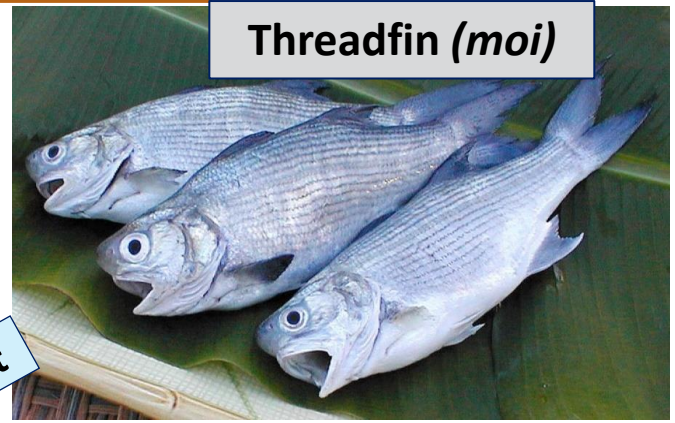
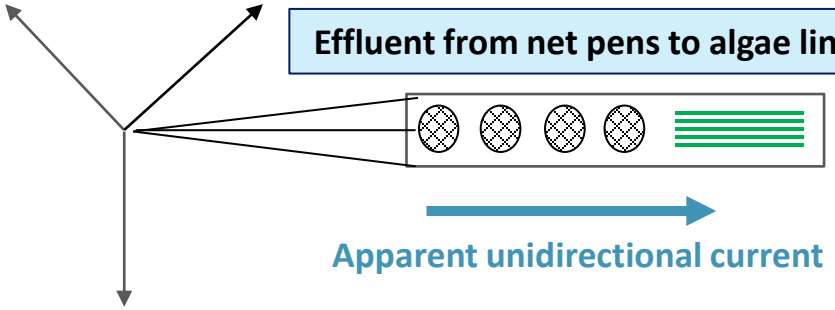
Commercial Opportunities/T2M

Co-culture of carnivorous and herbivorous fish, and macroalgae on SPM



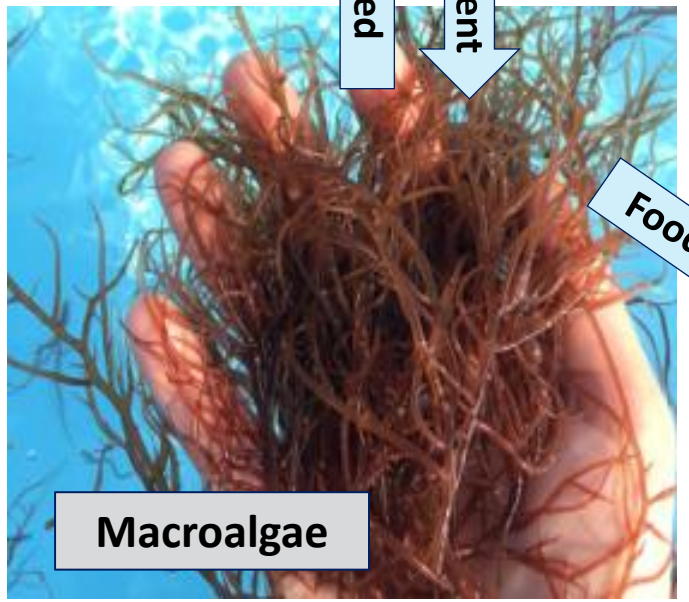




Feed

Effluent

Effluent



Food

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Future Vision

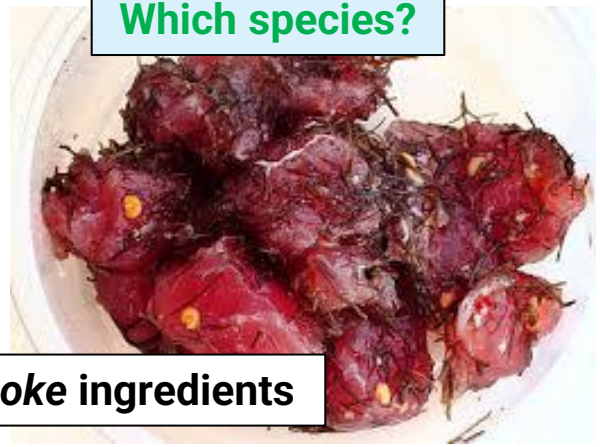
Paths to Market: Food / Feeds / Fertilizers / Fuels / C-Footprint (CCS)

Potential Market Size / Value / Impact = inversely correlates with 'realizability'

Food: Robust Hawaiian market

Limu delicacies

Which species?



***Poke* ingredients**

Feeds: Fresh limu -> herbivorous fish

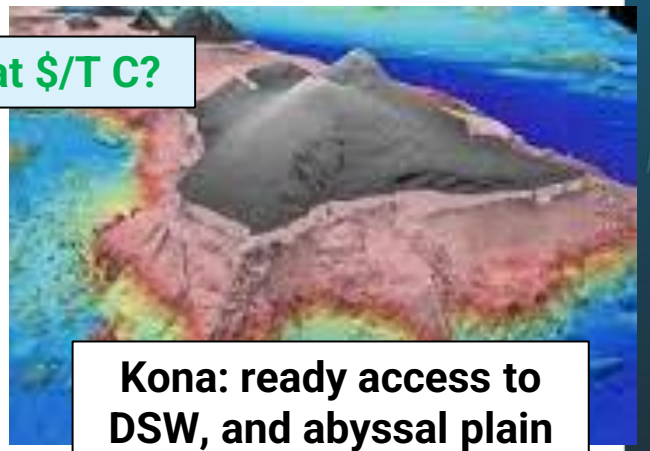
Which species?

Fertilizers

Wild harvest competition

C-Footprint (CCS)

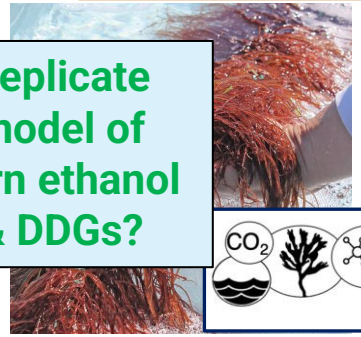
What $/T C?



Kona: ready access to DSW, and abyssal plain

Feeds: KRuMBS additives

Replicate model of corn ethanol & DDGs?



Fuels → **Future**

Thank you!

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